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THE SEATTLE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

FROM June 17 to June 22, inclusive, the American Association for the Advancement of Science and the Pacific Division of the Association held a joint meeting in Seattle, Washington. This was the one hundred sixth meeting of the association and the twenty-fourth meeting of the Pacific Division. The Pacific Division met in Seattle in June, 1936; this was the first meeting of the association in the state of Washington.

To the residents of the eastern part of the United States, and even to those of the Middle West, Seattle seems to be very remote and not easily accessible. It is indeed distant from these regions, counting distances as they were counted only a few years ago. But

ribbons of concrete, streamlined trains and airplanes have reduced distances so much that 89 members from east of the Rocky Mountains registered at the meeting. The attractions were not only a delightful climate and some of the finest scenery in the world but excellent scientific programs.

To expect anything less than a good meeting of the association in Seattle would be to ignore essential factors. Seattle is a city of nearly 400,000 inhabitants; a city which, like ancient Rome, sits on seven hills. The University of Washington has more than 12,000 students. Westerners are used to wide open spaces and are accustomed to travel, as is illustrated

by the fact that although nearly 1,000 miles stretch between San Francisco and Seattle, there were 164 registrants at the meeting from California. There were Canadians from Alberta and Manitoba, as well as from nearer British Columbia, 28 of whom registered. In all there were 673 registrants, compared with 331 at the meeting held in Milwaukee, Wisconsin, in June, 1939.

At the Seattle meeting 27 affiliated and associated societies participated in the programs and a total of 644 addresses and papers were delivered or read. These addresses and papers ranged widely over the fields of the physical, biological and social sciences. Especially in the natural sciences, each of them recorded some increase in knowledge of a universe that its author was finding to be orderly and understandable. While the scientists were thinking of science there was only happiness in their hearts. But when they read the European news in the daily press a cold fog settled over them. What a commentary on "the Lords of Creation" that they find order in all the universe, both physical and biological, except in the domain of their own minds and actions! Perhaps the restlessness, ambition, greed and ruthlessness that lead from time to time to conquests are among the qualities of our race that have enabled it to rise above and dominate all other species. It is the hope and possibly the promise of science that it will be able to point out other and even more rapid ways to human progress. It can not be expected, however, that any deep-seated human characteristics will rapidly be changed. And is it not true that the ability to change implies the possibility of taking a road toward disaster as well as toward success? Can there be a capacity for happiness without there being at the same time a capacity for suffering?

Fortunately, in the Seattle region there are almost unparalleled opportunities for profitable and enjoyable excursions by scientists. Many groups under competent leaders visited the forests, the arms of the ocean or the mountains. In addition to increasing their knowledge of their own specialties, the participants in these excursions enlarged their perspectives in space and time and enjoyed the healing effects of mountains and sea and growing things.

The excursions were only one of the provisions made for the comfort, entertainment and advantage of visitors by a very competent and efficient Local Committee on Arrangements under the able chairmanship of Dr. A. F. Carpenter, executive officer of the department of mathematics of the University of Washington. The duties of the committee were largely assigned to a number of special committees: Excursions, H. A. Coombs, *chairman*; Finance, H. E. Smith, *chairman*; Meeting Places and Equipment, M. H. Hatch, *chair-*

man; Program, D. H. Loughridge, *chairman*; Publicity, B. H. Christian, *chairman*; Reception and Entertainment, H. P. Riley, *chairman*, and Transportation, A. V. Eastman, *chairman*. The officers of the association and all who attended the meeting in Seattle owe a debt of gratitude to these committees and to the University of Washington.

REGISTRATION

There were about 1,100 persons in attendance at the various scientific sessions, exclusive of the general sessions to which the public was invited. The total registration was 673, distributed as follows: Alaska, 1; Arizona, 6; California, 164; Colorado, 3; Connecticut, 2; District of Columbia, 7; Hawaii, 3; Idaho, 28; Illinois, 8; Indiana, 2; Iowa, 1; Louisiana, 1; Maryland, 1; Massachusetts, 3; Michigan, 1; Minnesota, 5; Missouri, 2; Montana, 16; Nebraska, 2; Nevada, 6; New Hampshire, 1; New Jersey, 3; New York, 11; North Dakota, 1; Ohio, 9; Oklahoma, 1; Oregon, 116; Pennsylvania, 5; South Dakota, 1; Tennessee, 1; Texas, 2; Utah, 7; Washington, 216; Wisconsin, 6; Canada, 28; France, 1; Peru, 1; Philippines, 1.

GENERAL SESSIONS

On Tuesday evening, June 18, Dr. Lewis M. Terman, president of the Pacific Division and distinguished head of the department of psychology of Stanford University, delivered an address on "Psychological Approaches to the Biography of Genius." Dr. Albert F. Blakeslee, president of the association, presided and introduced Dr. Terman. A large and appreciative audience listened attentively to Dr. Terman's discussion of his long-continued investigations of exceptionally talented persons.

On Wednesday afternoon, June 19, Dr. Donald Milton Erb, president of the University of Oregon, delivered an excellent address under the sponsorship of Pi Gamma Mu, a national social science honor society, on "Perspective in the Social Sciences." Dr. S. Howard Patterson, national president of Pi Gamma Mu, presided.

On Wednesday evening, June 19, Dr. Edwin P. Hubble, astronomer of the Mt. Wilson Observatory, delivered the ninth Hector Maiben Lecture, an illustrated address on "Problems in Nebular Research." Dr. Albert F. Blakeslee, president of the association, presided and introduced Dr. Hubble, who discussed his investigation of exterior galaxies and the apparently adverse evidence he has secured on the theory of an expanding universe.

On Thursday evening, June 20, Mr. S. E. Hutton, of the Bureau of Reclamation, U. S. Department of the Interior, delivered an illustrated address on "The Columbia Basin Reclamation Project and the Con-

struction of the Grand Coulee Dam." Dr. Albert F. Blakeslee, presided.

SYMPOSIA

Fourteen principal symposia were presented at the meeting, ranging in subject-matter from cosmic rays to virus diseases of fruit trees. They were as follows:

1. *Cosmic Rays*, organized by American Physical Society. Scheduled participants in the symposium were Hans A. Bethe, Arthur H. Compton and Robert A. Millikan.
2. *Sources of Stellar Energy*, organized jointly by American Physical Society and Astronomical Society of the Pacific; papers by G. M. Volkoff and Dean B. McLaughlin.
3. *Nuclear Moments*, organized by American Physical Society; papers by N. F. Ramsey and J. R. Zacharias.
4. *The Present Crisis in the Quantum Theory of Fields*, an informal symposium organized by American Physical Society. Discussion was led by J. R. Oppenheimer.
5. *The Photoelectric Cell in Astrophysical Research*, organized by the Astronomical Society of the Pacific; 5 papers.
6. *Alaska—its Resources and its Problems*, organized by Section on Geology and Geography and Geological Society of America. The symposium consisted of two sessions at which 11 papers were read.
7. *The Species Problem*, presented under the joint auspices of the Section on Zoological Sciences, the Section on Botanical Sciences and the Western Society of Naturalists. The symposium was presented in two sessions, Robert C. Miller presiding, at each of which four papers were read.
8. *Salmon Problems on the Pacific Coast of North America*, organized by American Society of Ichthyologists and Herpetologists, Western Division. The symposium was presented at two sessions, W. M. Chapman, presiding, at each of which four papers were read.
9. *Aquatic Botany*, organized by Section on Botanical Sciences, Botanical Society of America, Pacific Division, and American Society of Plant Physiologists, Western Section. The symposium, at which George B. Rigg presided, consisted of six papers.
10. *Recent Investigations of the Characteristics of the Photosynthetic Process*, organized by Section on Botanical Sciences, Botanical Society of America and American Society of Plant Physiologists. The symposium was presented in two sessions, H. A. Spoehr presiding, at the first of which four papers were read and at the second of which three papers were read.
11. *Social and Economic Problems of the Pacific Northwest in Relation to their National Setting*. This symposium, organized by the Section on Social and Economic Sciences, consisted of 5 sessions as follows: (a) Population Trends with special Reference to the Pacific Northwest (J. F. Steiner, chairman; 5 papers); (b) Migration and Settlements: Patterns and Trends (John B. Appleton, chairman; 7 papers); (c) The Economy of the Pacific Northwest in its National Setting (Donald Milton Erb, chairman; 6 papers); (d) Standards of Living and Em-

ployment: Problems of Community Insecurity (W. F. Ogburn, chairman; 5 papers); and (e) Employer-Employee Problems and Relations (Wayne L. Morse, chairman; 7 papers).

12. *Forest Influences and Land Use Problems*, organized by Ecological Society of America and Society of American Foresters. The presiding officers were C. S. Cowan and John H. Hanley; 4 papers.

13. *Virus Diseases of Fruit Trees*, organized by American Phytopathological Society. Symposium consisted of two sessions, 6 papers read at the first and 5 at the second.

14. *Phosphate Nutrition and Phosphate Fertilization*, organized by Western Society of Soil Science and American Society of Plant Physiologists, Western Section. H. D. Chapman, chairman; 4 papers.

SCIENTIFIC SESSIONS

AMERICAN MATHEMATICAL SOCIETY

(From report by T. M. Putnam)

The feature of the program of the society was a joint session with the American Physical Society, at which John von Neumann presented a paper "On Operator Rings and Dimensions." There were two other sessions, at which 15 papers were presented before an audience of 52 persons. The society held a joint dinner with the Section on Mathematics.

AMERICAN PHYSICAL SOCIETY

(From report by Paul Kirkpatrick)

The society organized 2 symposia, participated with the Astronomical Society of the Pacific in a third symposium and held a joint session with the American Association of Physics Teachers for a program on "Training of Physicists at the Graduate Level." The program consisted of 60 papers, and 225 different persons attended one or more sessions. The society held a luncheon at which Karl K. Darrow and Frederick Bedell spoke.

AMERICAN ASSOCIATION OF PHYSICS TEACHERS

(From report by A. A. Knowlton)

In addition to the joint session with the American Physical Society, the society held three sessions at which 4 invited and 17 contributed papers were presented. An interesting feature of the first session was an illustrated lecture by E. C. Watson on "The Life and Work of William Gilbert as Portrayed in Old Prints."

AMERICAN METEOROLOGICAL SOCIETY

The society held 4 sessions at which 22 papers were presented, many of them pertaining to meteorological problems of the Pacific Northwest.

AMERICAN CHEMICAL SOCIETY

The society held 4 sessions at which 32 papers were

presented, 8 at each session. The meeting was a Western Intersectional Meeting of the society under the chairmanship of H. V. Tartar.

ASTRONOMICAL SOCIETY OF THE PACIFIC

(From report by T. S. Jacobsen and N. U. Mayall)

In addition to presenting a symposium on "The Photoelectric Cell in Astrophysical Research" and organizing a symposium and holding a joint session with American Physical Society on "Sources of Stellar Energy," the society held 3 sessions, at which 17 papers were presented. It also held an evening session, at which R. M. Petrie, of Victoria, B. C., Canada, delivered a lecture on "Solar Kinematography" illustrated by motion pictures taken at the McMath-Hulbert Observatory. The speakers at a dinner of the society were Paul W. Merrill and Joel Stebbins.

SECTION ON GEOLOGY AND GEOGRAPHY AND GEOLOGICAL SOCIETY OF AMERICA

(From report by Howard A. Meyerhoff)

In addition to presenting a symposium on "Alaska—its Resources and its Problems," in two sessions at which 11 papers were read, the section and the society held 4 sessions at which 42 papers were presented and organized a 300-mile petrologic field excursion, under the leadership of G. E. Goodspeed, a 150-mile glacial field excursion, under the leadership of J. Hoover Mackin, and a 3-day Cascade-Columbia Plateau field excursion, under the leadership of Richard F. Flint, Richard E. Fuller, G. E. Goodspeed, J. Hoover Mackin and A. C. Waters. About 110 persons attended the sessions of the section.

AMERICAN GEOPHYSICAL UNION, SECTION OF HYDROLOGY

(From report by George G. West)

The society held 3 sessions, at which the respective chairmen were Phil E. Church, J. C. Stevens and O. W. Monson, and at which 5, 3 and 4 papers, respectively, were read. At a joint luncheon on the first day with Western Interstate Snow Survey Committee and American Meteorological Society, Ukitiro Nakaya, of Hokkaido University, Japan, exhibited a sound film on "Formation of Snow Crystals in the Mountains and in the Laboratory in Japan." At a second joint luncheon the Washington Water Power Company exhibited a motion picture on "From the Snow Field to the Home." At a joint dinner with the Western Interstate Snow Survey Committee a motion picture on Snow Surveys was shown. An interesting feature of the meeting of the society was an exhibit of instruments used in the collection of hydrologic data.

OCEANOGRAPHIC SOCIETY OF THE PACIFIC

The society held a conference on "The Distribution and Cycle of Organic Matter in the Ocean."

ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

The society, in its sixth annual meeting, held 6 sessions, at which 31 papers were presented, and a dinner, at which Peveril Meigs, president of the society, delivered an address on "Exploring American Orchards" and at which a motion picture on "Wheat Farming and Conservation in the Palouse" was shown. The society joined in an excursion around Seattle Harbor.

WESTERN INTERSTATE SNOW SURVEY CONFERENCE

The society held 4 sessions, at which 23 papers were presented. The first was on "Forecasting," R. A. Work, *chairman*; the second, "Equipment," R. C. Farrow, *chairman*; the third, "Activities," O. W. Monson, *chairman*, and a fourth session for the reading of miscellaneous papers. In addition, the society held a dinner, H. P. Boardman, presiding, at which a color motion picture on "Snow Surveying in the Central Sierra" was shown by Walter Herz and at which 9 speakers participated in a discussion of "Accuracy of Forecasts in Pacific Northwest in 1938-1939."

SECTION OF ZOOLOGICAL SCIENCES

(From report by George A. Baitsell)

The section held two joint sessions with the Section on Botanical Sciences and Western Society of Naturalists, at which a symposium on "The Species Problem" was presented under the chairmanship of Robert C. Miller. About 100 persons were in attendance at the reading of the papers and about 125 at the Biologists' dinner.

AMERICAN SOCIETY OF ECONOMIC ENTOMOLOGISTS, PACIFIC SLOPE BRANCH

(From report by Roy E. Campbell)

The society held a joint session with Northwest Association of Horticulturists, Entomologists and Plant Pathologists, American Phytopathological Society and American Society for Horticultural Science, Don C. Mote, presiding, at which 11 papers were presented. It also held 3 other sessions, at which 30 papers were read. The sessions of the society were attended by about 125 persons.

AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS, WESTERN DIVISION

(From report by Margaret Storey)

In addition to the symposium on "Salmon Problems on the Pacific Coast of North America," presented in 2 sessions, the society held 2 sessions for the reading of general papers and conducted an excursion to commercial establishments on the Seattle waterfront and frozen fish exhibit. Fifteen papers were presented, and the attendance on the programs of the society was over 150.

PACIFIC NORTHWEST BIRD AND MAMMAL SOCIETY

(From report by Arthur Sivilha)

The society, at its twentieth annual meeting, held 2 sessions at which 12 papers were presented and joined in an open meeting with American Society of Ichthyologists and Herpetologists.

THE SECTION OF BOTANICAL SCIENCE AND THE
BOTANICAL SOCIETY OF AMERICA,
PACIFIC DIVISION*(From report by Ira L. Wiggins)*

The section and the society joined with American Society of Plant Physiologists in the symposium on "Aquatic Botany" and "Recent Investigations of the Characteristics of the Photosynthetic Process," mentioned previously under "Symposia," 3 sessions, at which 21 papers were read, a 2-day excursion to the Olympic Peninsula and a joint excursion with American Society of Plant Physiologists to Friday Harbor.

AMERICAN PHYTOPATHOLOGICAL SOCIETY, PACIFIC
DIVISION*(From report by C. E. Yarwood)*

In addition to presenting a symposium on "Virus Diseases in Fruit Trees," the society held a joint session with American Association of Economic Entomologists, American Society for Horticultural Science and Northwest Association of Horticulturists, Entomologists and Plant Physiologists, at which 5 papers were presented, and 4 sessions of its own, at which 30 papers were read.

AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS,
WESTERN SECTION*(From report by J. Van Overbeek)*

The society participated with other societies in symposia on "Phosphate Nutrition and Phosphate Fertilization," "Aquatic Botany" and "Recent Investigations of the Characteristics of the Photosynthesis Process" (see "Symposia," *ante*), held a joint session, under the chairmanship of William M. Atwood, with American Society for Horticultural Science, at which 7 papers were read, two sessions under the chairmanship of A. S. Crafts, at which 6 papers were read, and conducted a trip to the Oceanographic Laboratories of the University of Washington at Friday Harbor, San Juan Islands. A total of 27 papers was presented in the programs of the society which were attended by about 100 different persons.

ECOLOGICAL SOCIETY OF AMERICA

(From report by H. de Forest)

In addition to joining with Society of American Foresters in the symposium, "Forest Influences and Land Use Problems," the society held two sessions,

one under the chairmanship of H. de Forest and the other under the chairmanship of Frederick A. Davidson, at which 10 papers were read.

WESTERN SOCIETY OF NATURALISTS

The society participated in the symposium on "The Species Problem."

SECTION ON ANTHROPOLOGY

(From report by Erna Gunther)

The section held two sessions, Erna Gunther and Verne F. Ray, presiding, at which 6 papers were presented. The attendance at the sessions was about 30 persons.

SECTION ON PSYCHOLOGY

(From report by Leonard Carmichael)

Under the excellent guidance of John E. Corbally and with the assistance of Stevenson Smith and Edwin R. Guthrie, a program was worked out for the section jointly with the Section on Education.

The first (morning) session was about equally divided between papers in psychology and education. At the joint luncheon of the sections which followed, the secretaries discussed the relationship between psychology and education and the other sciences represented in the A.A.A.S.

In the afternoon a panel discussion on the utilization of community resources for educational purposes was participated in by 6 experts in this field. The section also cooperated with the Society for Research in Child Development in 2 programs. The first of these consisted in the presentation of 5 papers in the field of the physical and mental development of young children. "The Application of Research to Practical Work with Children" was the topic of a panel discussion in the other general meeting of this society.

SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT

(From report by Stevenson Smith)

The society held 2 sessions, one at which 5 general papers were read, and a panel discussion on "Application of Research to Practical Work with Children." Attendance, 88.

SECTION ON SOCIAL AND ECONOMIC SCIENCES

(From report by E. P. Hutchinson)

The section program, prepared by a local committee under the chairmanship of Kenneth O. Warner, of the Northwest Regional Council, consisted of a symposium on social and economic problems of the Pacific Northwest. The 5 sessions dealt in succession with population trends in the area, the pattern of migration and settlement, economic problems of the Northwest in relation to the national setting, the local standard of living and lastly the labor situation. Among the par-

ticipants in the discussion were J. F. Steiner, John B. Appleton, Paul Landis, Richard A. Lester, Donald M. Erb and W. F. Ogburn, together with representatives of various state and federal agencies. The symposium began with a statement of the size and composition of the population of the area and the extent of the problem of dependency. From there it proceeded to a consideration of the migration trends and the prospects for future growth, surveyed the outlook for the economy of the area, considered the existing standard of living as compared to that of other sections of the country, and concluded with a discussion of employer-employee relations.

INSTITUTE OF THE AERONAUTICAL SCIENCES

The program of the society consisted of 2 sessions, under the chairmanship of Frederick Kurt Kirsten, for the presentation of papers and a dinner at which the Musick Memorial Trophy for 1940 was presented. Wolfgang B. Klemperer exhibited interesting color motion pictures of "High Altitude Flight without Power," and a color sound film on "Transpacific Flight" was shown. During the presentation of the important paper on "High Altitude and its Effects on the Human Body," by Drs. Randolph Lovelace, William M. Boothby and O. O. Benson, Dr. Lovelace entered a decompression chamber in which the atmospheric pressure was reduced to that at an altitude of 33,000 feet, from which he was returned to normal pressure in less than a minute.

SOCIETY OF AMERICAN BACTERIOLOGISTS, SOUTHERN CALIFORNIA BRANCH AND NORTHERN CALIFORNIA-HAWAIIAN BRANCH

(From report by Ernest C. McCulloch)

The society had a program of 20 papers, 17 of which were read at two sessions. The attendance was about 55. Notable papers were "A Study of Living Forms of Infectious Myxoma by High Power Microscopy," by R. E. Hoffstadt, and "Carbon Dioxide Assimilation by Propionic Bacteria Studied by the Use of Radioactive Carbon," by S. F. Carson.

SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE, PACIFIC COAST BRANCH AND SOUTHERN CALIFORNIA BRANCH

(From report by Walton Van Winkle, Jr.)

The society held 2 sessions at which 29 papers were presented. The attendance was about 75.

AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, WESTERN SECTION

(From report by C. L. Vincent)

The society held 5 sessions under the general chairmanship of E. L. Overholser, one being a joint session with Northwest Association of Horticulturists, Entomologists and Plant Pathologists, American Phyto-

pathological Society and American Association of Economic Entomologists. At the sessions of the society 29 papers were read and the attendance was about 120.

SOCIETY OF AMERICAN FORESTERS

(From report by G. D. Marckworth)

The society held four sessions at which 15 papers were presented and which were attended by about 75 persons. The subject for consideration at the first session was "Forest Resources," William H. Price, chairman. The second session, under the chairmanship of Lyle F. Watts, was devoted to "Cutting Practices in Various Northwest Forest Types"; the third, under the chairmanship of Hugo Winkenwerder, to "Utilization Problems of the Northwest; and the fourth, with C. S. Cowan serving as chairman, to "Forest Influences and Land Use Problems." A field trip of 26 persons was taken to the Cedar River Water Shed (Seattle's Municipal Forest) and the operations of the Cascade Logging Company.

WESTERN SOCIETY OF SOIL SCIENCE

(From report by L. T. Kardos)

In addition to participating in the symposium on "Phosphate Nutrition and Phosphate Fertilization," the society held 3 sessions, at which 20 papers were read. Its programs were attended by a total of about 100 persons. The symposium was followed the next day by a round table discussion, under the chairmanship of R. A. Walker, of "Coordination of Research Programs in Western Phosphate Utilization."

NORTHWEST ASSOCIATION OF HORTICULTURISTS, ENTOMOLOGISTS AND PLANT PATHOLOGISTS

The society participated with entomologists, phytopathologists and horticulturists in a discussion of the use of statistical methods. A paper on "Relations of Plant Viruses to the Tissues of Hosts," by Katherine Esau, was especially important. The society held a demonstration program at the Western Washington Experiment Station at Puyallup as a part of a field trip with the Pacific Division of the American Phytopathological Society to various orchards, vegetable farms and berry fields. The total attendance was 118.

SECTION ON EDUCATION

(From report by John E. Corbally)

The section held two sessions with the Section of Psychology (see report of the section, *ante*). The general topic considered at the first session was "Learning Attitudes," and "The Utilization of Community Resources for Educational Purposes" at the second. About 200 persons attended the first session and 150 the second.

AN ELECTRON MICROSCOPE FOR THE RESEARCH LABORATORY

By Dr. V. K. ZWORYKIN

RCA MANUFACTURING COMPANY, CAMDEN, N. J.

FOR some time scientists have been aware that a considerable increase in the resolving power of microscopes could be obtained if it should prove possible to substitute for light a medium of much shorter wavelength which, like light, could be "focused"—i.e., used to form images. High velocity electrons, having wavelengths one-one hundred thousandth that of light and capable of being focused by axially symmetric magnetic and electric fields, constitute just such a medium. Certain fundamental peculiarities of these electron lens fields appear to prevent, it is true, an approach to an improvement in resolution corresponding to the ratio of the wave-lengths of these electrons and of light. Nevertheless, workers both here and abroad have

demonstrated beyond doubt an increase in resolution by a factor of twenty to a hundred times.

There could be no question that an instrument having resolution capabilities one or two orders of magnitude greater than is possible with the ordinary microscope would be of incalculable value in countless researches both of a purely scientific and of an industrial nature. On the other hand, the construction and installation of an "electron microscope" introduces problems quite outside of the sphere of either the optician or the conventional microscopist. This situation caused the RCA laboratories, with their accumulated experience in electronics, electron optics and vacuum technique, to undertake the task of construct-

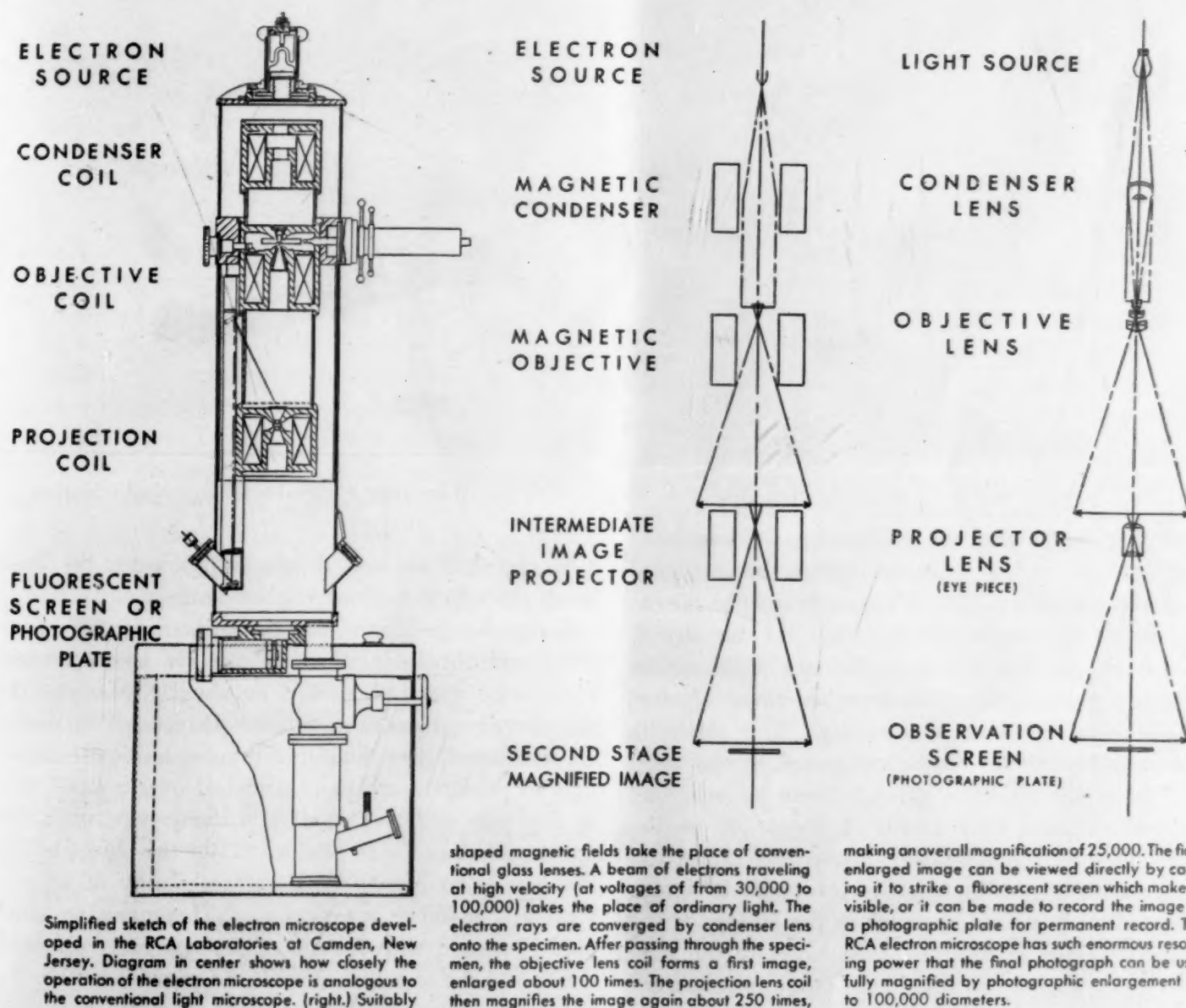


FIG. 1. Simplified sectional view of the RCA Electron Microscope.

ing an electron microscope suitable for all types of research problems.

The microscope¹ was designed by L. Marton in cooperation with other staff members. Emphasis has been placed not only on attaining the highest resolution possible, but also on ease of operation, insensitivity to disturbances and safety. A simplified sectional view of the instrument is shown in Fig. 1.

At the top, some eight feet from the floor level, is the electron source, a hairpin filament of tungsten surrounded by a guard cylinder. It is the only part of the microscope at a high potential—30 to 100 kilovolts—above ground. Electrons leaving the filament are accelerated by the strong electric field between the

able photographic plate or fluorescent screen below. This final image has a magnification of up to 25,000. Added detail may be brought out on the plates thus obtained by photographic enlargement, bringing the total magnification up to 100,000.

The body of the microscope is made up of two large brass cylinders. This construction lends it rigidity and makes it insensitive to mechanical shock. Magnetic shielding is provided for the entire path of the electrons from the object to the final image.

The lenses consist of coils of magnet wire provided with soft iron shields so shaped as to give a desirable magnetic field distribution along the axis of the microscope. As the entire body of the microscope is evacu-



FIG. 2. Typhoid bacillus. Magnification 10,000 \times .

cathode (filament and guard cylinder) and anode, pass through a hole in the latter and enter the magnetic field of the condenser lens. This, as in a light microscope, serves to concentrate the beam on the object, which, itself, is placed within the lens field of the objective, a position favorable from the point of view of minimizing the lens aberrations. The electrons which pass through the object are guided by the magnetic field of the objective so as to form an image of the object enlarged by a factor of about 100 on the fluorescent screen immediately above the projection coil. A central portion of this intermediate image corresponding to a free aperture in the middle of the fluorescent screen is enlarged once more by the projection coil, forming the final image on an interchange-

¹ For a more detailed description see L. Marton, "A New Electron Microscope," *Physical Review* (in press).



FIG. 3. Whooping cough bacteria. Magnification 9,000 \times .

ated, the coils are sealed into copper cans, the leads being brought out through glass-to-metal seals.

A suitable technique for the preparation of specimens and for their introduction into the evacuated microscope was first worked out by Dr. Marton. In the microscope under discussion the object is placed on a nitrocellulose film less than a millionth of an inch in thickness, which is stretched over a small disk of fine wire cloth. This disk is clamped between two apertures in a pair of blades. After the object holder has been introduced into the forechamber of an airlock, this chamber is evacuated. Thereupon an inner gate is opened with the aid of an externally operated crank and the object is moved into position within the objective. Further screws and gears, manipulated externally, translate the object horizontally and ver-



FIG. 4. Streptococcus germs. Magnification 20,000 \times .

tically relative to the objective. This arrangement makes it an easy matter to explore the specimen by manipulating controls from the observer's position.

In studying the object the observer is seated in front of the microscope and views the final image through one of the large rectangular windows provided for that purpose, with the current and voltage controls within easy reach. A periscope at the left end of the window permits the observation of the less highly magnified intermediate image from the same position.

If a photograph is to be taken, a photographic plate is introduced through a second airlock, the fluorescent screen is swung aside and an exposure made. The airlock mechanism opens and closes the plate holder automatically as the plate is introduced and again withdrawn.

To illustrate some possibilities of application of this electron microscope, a few pictures obtained with it



FIG. 5. Iron-oxide powder (rouge). Magnification 15,000 \times .

are reproduced in Figs. 2 to 5. The first three represent various pathogenic bacteria. Here the long curved flagella of the typhoid germ and the interior structure visible in the whooping cough bacteria are particularly interesting. The last picture, showing a sample of polishing rouge, indicates the usefulness of the instrument for determining the size and shape of particles beyond the reach of the light microscope.

A conservative estimate based on the examination of pictures so far obtained makes the resolving power of the present electron microscope twenty times that of the best light microscopes with oil immersion. There is every probability that research now being carried on will greatly increase this factor. The significance of this newly found sight, extended to the range of the larger organic molecules, in all branches of science—biology, medicine, metallurgy, etc.—can scarcely be gauged. Once again, an apparently insurmountable obstacle to the progress of science has been overcome.

SCIENTIFIC EVENTS

THE HARVARD SCHOOL OF DENTAL MEDICINE

A NEW plan of dental education made possible by contributions amounting in all to \$1,300,000 has been inaugurated at Harvard University. The gifts were made by: The Carnegie Corporation, \$650,000 in addi-

tion to a gift of \$350,000 made in 1937; the Rockefeller Foundation, \$400,000; and the John and Mary R. Markle Foundation, \$250,000. This foundation had contributed previously the sum of \$25,000.

Under the plan, which is described in the *Harvard Alumni Bulletin*, the present Harvard Dental School

will be renamed the Harvard School of Dental Medicine. Its course, to be initiated in the autumn of 1941, will be extended from four to five years, and will combine in increased measure the basic knowledge and skills of both medicine and dentistry.

Dental students will register in both the new School of Dental Medicine and in the Harvard Medical School, taking three and a half years of the same medical courses as other students in the Harvard Medical School, and in addition one and a half years of specific dental training. Graduates will receive both the M.D. and D.M.D. degrees. Admissions to the School of Dental Medicine will be governed by the same standards and the same committee which govern admissions to the Harvard Medical School.

In the first year of the five-year course, students will spend approximately five per cent. of their time in specific dental training, and the remaining 95 per cent. in medical training. The proportion of dental training will rise to 10 per cent. in the second year, 20 per cent. in the third year, 37 per cent. in the fourth year, and 88 per cent. in the final year.

In addition to the contributions of the three foundations named, the president and fellows have transferred definitely to the resources of the School of Dental Medicine \$1,000,000, tentatively placed at the disposal of the school ten years ago. An additional \$250,000 is required to bring the plan into operation; but it has been announced that there is expectation of finding a means to provide this balance. It has been decided, accordingly, to proceed with the plan. When this last balance is provided, the permanent new assets for teaching and research will amount to \$2,550,000.

THE GUGGENHEIM FELLOWSHIPS FOR LATIN AMERICANS

Brazilian scholars, competing for the first time for the Latin American fellowships offered by the John Simon Guggenheim Memorial Foundation, have been awarded six of the nineteen fellowships granted for 1940-41. Three fellowships were granted to Peruvians. Argentina, Chile, Uruguay and Puerto Rico each received two fellowship awards, Mexico and Cuba one each.

Fellowships in the sciences include:

CARLOS NICHOLSON JEFFERSON, professor of the physical geography and climatology of Peru in the University of San Agustín, Arequipa, will engage in comparative studies of the climates of the Peruvian coast and the coast of California.

DR. FERNANDO HUIDORBO TORO, surgeon and member of the staff, Catholic University of Chile: Studies of the chemical transmission of nerve impulses.

DR. RAUL PALACIOS, chief of the section of filterable viruses of the Bacteriological Institute of Chile: Studies of rabies.

DR. AMERICO SANTIAGO ALBRIEUX MURDOCH, head of the section of endocrinology, Institute of Endocrinology, Montevideo, Uruguay: Studies in the field of endocrinology, in particular, hormone therapy.

DR. CIRO A. PELUFFO, assistant in the Department of Bacteriology, Institute of Hygiene, Montevideo, Uruguay: Studies of artificially induced microbiological variation.

DR. HUGO PABLO CHIOLDI, laboratory chief, Pulmonary Research Center, University of Buenos Aires: Investigation of respiratory phenomena caused by muscular activity in health and disease.

DR. EDUARDO ETZEL, chief surgeon, Clemente Ferreira Tuberculosis Institute, São Paulo, Brazil: Technical studies of thoracic surgery in relation to the treatment of pulmonary tuberculosis.

DR. NILSON TORRES DE REZENDE, surgeon, Pernambuco, Brazil: Studies in the field of neurophysiology.

DR. MAURICIO ROCHA E SILVA, member of the staff of the Biological Institute of São Paulo, Brazil: Research into the pharmacological properties of trypsin.

CARLOS ARNALDO KRUG, head of the Genetics Department, Institute of Agronomy of São Paulo, Brazil: Genetic investigations of citrus and other major crop plants of Brazil, in collaboration with experts of the United States Department of Agriculture.

JOSÉ P. CARABIA, assistant in the Botany Department of La Salle College, Havana, Cuba: The preparation of a work on the flora of Cuba, at the New York Botanical Garden, where there is gathered the world's largest collection of Cuban plants.

NABOR CARRILLO FLORES, professor of mathematics, National University of Mexico: Studies of soil mechanics and its application to the construction of foundations of buildings and dams with especial references to the difficult subsoil conditions of Mexico.

FACUNDO BUESO-SANLLEHÍ, associate professor of physics, University of Puerto Rico: Studies in the field of band spectra. Professor Bueso-Sanllehí, who has taught at the University of Puerto Rico since 1927, was born in Mexico.

MARIO SCHENBERG, acting professor of physics, University of São Paulo, Brazil: Research into the application of nuclear and atomic physics to astrophysics.

The grants are made in terms of fellowships to assist research workers in all fields of knowledge to carry on their work under the freest possible conditions. The stipends granted are usually \$2,000 for a year.

Dr. Frank Aydelotte, director of the Institute for Advanced Study at Princeton, is chairman of the Committee of Selection. Members of the committee include: Dr. Thomas Barbour, professor of zoology and director of the Museum of Comparative Zoology of Harvard University; Dr. Elmer Drew Merrill, Arnold professor of botany and administrator of the botanical collections of Harvard University, and Dr. Percival Bailey, professor of neurology and neurosurgery in the medical school of the University of Illinois.

FELLOWSHIPS OF THE ZOOLOGICAL SOCIETY OF SAN DIEGO

THE Zoological Society of San Diego announces that two fellowships are available to advanced graduate students for the pursuit of research work at the San Diego Zoological Research Laboratory on some phase of animal biology (concerned primarily with such branches as pathology, bacteriology, parasitology, physiology, comparative anatomy, comparative biochemistry, animal nutrition or animal psychology). The stipend of each scholarship is \$1,000 per annum.

The Zoological Hospital and Research Laboratory is supported by public appropriations and endowed funds, and is devoted to problems concerned with the health and normal life of animals, in and out of captivity, and to various phases of biological research. It is conducted in connection with the San Diego Zoological Gardens, which house 3,000 animals, including 175 species of mammals, 500 species of birds and 150 species of reptiles.

Research facilities include a two-story building with individual laboratory and office rooms. Refrigeration, incubation, x-ray equipment, microphotographic apparatus, microtomes, microscopes, etc., are available in the building. An extensive outdoor animal isolation yard houses all new animals and research material. New animals are continually arriving from different parts of the world, often presenting special problems in nutrition and health. There is a wealth of material for pathological, parasitological and anatomical study from the Zoological Gardens and other cooperating agencies.

Since the Zoological Research Laboratory is not directly affiliated with any university, it is desirable that the recipient of the scholarship work under the direction of the department from which he applies and preference will be given to candidates for an advanced degree, it being understood that only the thesis or dissertation requirements or parts thereof can be fulfilled at the laboratory.

The Research Committee of the institute is comprised of a group of local biologists who participate in the activities of the hospital and laboratory by invitation of the Board of Directors of the Zoological Society without compensation. Their counsel is available to students and research workers. Seminars are held at regular intervals.

Further information will be sent upon request. Applications should be forwarded to Chas. R. Schroeder, Zoological Research Laboratory, Balboa Park, San Diego, Calif., before June 15, 1940.

AWARD OF MEDALS OF THE ROYAL GEOGRAPHICAL SOCIETY

IN his presidential address at the annual general meeting of the Royal Geographical Society on June

24, Field-Marshal Sir Philip Chetwode announced, according to the *London Times*, that it was the pleasure of the King, the patron of the society, that the council of the society should make this year its usual recommendation for the award of the royal medals. He approved these recommendations, but signified that the gold medals could not be struck until after the war.

The Founder's Medal was awarded for the first time in the society's history to a man and his wife jointly, for the work done for geography by Mr. and Mrs. Harold Ingrams was indivisible. The president paid tribute to their work in connection with the Wadi Hadhramaut. The Patron's Medal was awarded to Lieutenant Alexander R. Glen, of the Royal Navy, for his expeditions in Spitsbergen and in North-East Land, in one of which he maintained two stations on the Ice Cap throughout the winter and established a whole new technique of wintering under the worst conditions and keeping perfect health.

The Victoria Medal for conspicuous merit in scientific geography was awarded to O. G. S. Crawford, archeology officer of the Ordnance Survey. The Murchison Grant was awarded to Peter Mott for his surveys in West Greenland. The Back Grant was awarded to Gerald Seligman for his glacier studies conducted last year on the Jungfrauoch. With a small team of specialists working in a laboratory which was excavated in the glacier curtain, and so kept automatically at freezing point, he had obtained important evidence of the method by which the snow of the névé became transformed into the ice of the glacier, and on the process of movement.

The Cuthbert Peek Grant was awarded to John Hanbury-Tracy for his work in southeastern Tibet and his more recent journey in South America. The Gill Memorial was awarded to Alexander King for his work in Jan Mayen in 1938.

THE NEW HAMPSHIRE MEETING OF MATHEMATICIANS

THE American Mathematical Society, the Mathematical Association of America and the Institute of Mathematical Statistics will meet at Dartmouth College from September 9 to 12. Before the American Mathematical Society a series of four colloquium lectures by Professor G. T. Whyburn, of the University of Virginia, on "Analytic Topology" will be given on Tuesday morning and afternoon, and on Wednesday and Thursday mornings. Professor Leonard Carlitz, of Duke University, will give an address entitled "Arithmetic of Polynomials in a Galois Field" on Thursday afternoon. There will be a joint session on Tuesday afternoon with the Institute of Mathematical Statistics. At a session of the institute on Wednesday morning Professor J. L. Doob, of the University of Illinois, will speak on "Probability as Measure" and

Professor R. von Mises, of Harvard University "On the Foundations of Probability and Statistics"; on Thursday morning there will be addresses by Professor J. Neyman, of the University of California, on the "Estimation by Intervals as a Problem in Classical Probability" and by Dr. J. F. Daly, of the Catholic University, on "Statistical Estimation in Large Samples."

The Mathematical Association will hold two sessions on Thursday, one in the morning and one in the afternoon.

A joint dinner of the societies will be held on Tuesday evening at seven o'clock in Thayer Hall. On Monday evening at 8 o'clock there will be an entertainment in Dartmouth Hall, followed by an open house. During the evening there will be an exhibition of a collection of string models of ruled surfaces constructed by Professor Robin Robinson.

On Wednesday afternoon there will be an excursion to Franconia Notch in the White Mountains. Busses will leave Massachusetts Row at 1:30 P.M. It is expected that the busses will return to Hanover between 8 and 9 P.M. A picnic lunch *en route* is planned.

RECENT DEATHS

DR. CHARLES PURYEAR, dean emeritus of the Agricultural and Mechanical College of Texas, died on July 11. He was seventy-nine years old. Dr. Puryear was professor of mathematics at the college from 1890 to 1932.

ARTHUR HOLMES HOWELL, senior biologist of the

Bureau of Biological Survey of the U. S. Department of Agriculture, now a division of the Fish and Wild Life Service, died on July 10 at the age of sixty-eight years. Mr. Howell became a member of the staff of the Biological Survey in 1895.

DR. ALVAH HORTON SABIN, consulting chemical engineer of the National Lead Company, died on July 8 at the age of eighty-nine years.

DR. JOSEPH WILLIAMS SCHERESCHEWSKY, medical officer in charge of cancer investigations of the U. S. Public Health Service, associate in preventive medicine and hygiene at the Harvard Medical School, died on July 9. He was sixty-seven years old.

THE death is announced of Dr. Hans Virchow, professor of anatomy at the University of Berlin.

Nature records the death of Sir Thomas Hudson Beare, regius professor of engineering in the University of Edinburgh, on June 10, aged eighty years; of Oliver Gatty, research chemist, aged thirty-two years, and A. S. Chessum, research engineer, aged twenty-seven years, during an experiment in connection with air-raid precautions, on June 5; of Sir Jocelyn Thorpe, emeritus professor of organic chemistry of the University of London and in the Imperial College of Science and Technology, on June 10, aged sixty-seven years. Sir Arnold Wilson, distinguished for his administrative work in India and Persia, chairman of the British Industrial Health Research Board from 1926 to 1933, has been reported by the War Office as missing.

SCIENTIFIC NOTES AND NEWS

DR. RICHARD C. TOLMAN, of the California Institute of Technology, has been elected vice-chairman of the Defense Research Committee recently appointed by President Roosevelt with Dr. Vannevar Bush, president of the Carnegie Institution of Washington, as chairman. Brigadier General G. V. Strong, assistant chief of staff of the Army, and Rear Admiral Harold G. Bowen, director of the Naval Research Laboratory, have been assigned to this committee as representatives, respectively, of the War and Navy Departments. Other members of the committee are: President Karl T. Compton, of the Massachusetts Institute of Technology; President James B. Conant, of Harvard University; Dr. Frank B. Jewett, president of the National Academy of Sciences, and Commissioner of Patents Conway P. Coe.

THE new laboratory of the National Advisory Committee for Aeronautics, at Moffett Field, Calif., will be named for President Emeritus J. S. Ames, of the Johns Hopkins University, who was chairman of the

committee for twenty years before his retirement last autumn.

HAROLD EARLE THOMPSON, vice-president and chief engineer of the Carbide and Carbon Chemicals Corporation, New York, N. Y., received the degree of doctor of science from West Virginia University at its commencement exercises in recognition of "outstanding contributions to the fields of engineering and chemistry and his part in the development of the chemical industry of the Kanawha Valley."

COLGATE UNIVERSITY has conferred the doctorate of science on Charles Edward Wilson, president of the General Electric Company, and on Dr. Richard H. Hutchings, retired superintendent of the Marcy State Hospital at Utica.

IN addition to the awards in Group I for exhibits of individual investigation, which are judged on the basis of originality and excellence of presentation, made at the recent meeting in New York City of the

American Medical Association, which were reported in the issue of *SCIENCE* for June 21, awards were made to a second group not exemplifying purely experimental studies but judged on the basis of excellence of presentation and correlation of facts. In this group the gold medal was awarded to Norman Treves, Memorial Hospital, New York, for an exhibit illustrating the significance of the bleeding nipple; the silver medal to A. H. Logan, P. W. Brown, J. A. Bargen, H. M. Weber, L. A. Buie, H. H. Bowing, A. H. Baggenstoss, C. F. Dixon, J. deJ. Pemberton and C. W. Mayo, of the Mayo Clinic, Rochester, Minn., for an exhibit on Polyps of rectum and colon, and the bronze medal to W. H. Wright, National Institute of Health, for an exhibit illustrating the public health aspects of trichinosis.

DR. BERNARD W. HAMMER, professor of dairy industry at Iowa State College, has been presented with the Borden Award in recognition of outstanding research in dairy science. The award, consisting of a gold medal and \$1,000, was given at the annual convention of the American Dairy Science Association at Purdue University. Professor Hammer's most recent research has contributed to improvements in the flavor and quality of cheese and butter.

Nature states that a joint committee of the Royal Society of Edinburgh, of the Royal Physical Society and of the Royal Scottish Geographical Society has awarded the Dr. W. S. Bruce Memorial Prize (1940) to Brian Roberts, Emmanuel College, Cambridge, "for his valuable work in survey, ornithology and general biology in the north and south Polar regions."

THE Goethe Medal for art and science of the German Government has been awarded to Dr. Heinrich Ewald Herring, professor of normal and pathological physiology at Cologne; to Dr. Ludwig Kiessling, professor of agriculture and plant industry at Munich, and to Dr. Arthur Wehnelt, professor of physics at Berlin.

THE Union of German Chemists has awarded the Carl-Duisberg Memorial Prize to Dr. Hans Brockman, docent in organic chemistry at Göttingen, and the Adolf Fick Prize for physiology to Dr. Karl Lohmann, professor of physiological chemistry at Berlin.

OFFICERS of the Society for the Promotion of Engineering Education have been elected as follows: *President*, Donald B. Prentice, Rose Polytechnic Institute; *Vice-presidents*, L. E. Conrad, Kansas State College, and E. L. Moreland, Massachusetts Institute of Technology; *Secretary*, F. L. Bishop, University of Pittsburgh; *Treasurer*, W. O. Wiley, New York City, and *Assistant Secretary*, Nell McKenry, University of Pittsburgh. *Members of the Council* elected for a

term of three years are: C. S. Ell, Northeastern University; W. Otto Birk, University of Colorado; H. A. Curtis, University of Missouri; A. R. Cullimore, Newark College of Engineering; H. E. Degler, University of Texas; D. P. Savant, Georgia School of Technology, and George T. Seabury, American Society of Civil Engineers. The 1941 meeting will be held at the University of Michigan from June 23 to 27. The meeting for 1942 will be held in New York City.

DR. FREDERICK C. WAITE, for thirty-nine years a member of the faculty of the School of Medicine of Western Reserve University, retired at the end of the academic year with the title professor emeritus of histology and embryology.

DR. GEORGE WAGONER has been appointed professor of orthopedic research and director of the Laboratory of Research in Orthopedic Surgery in the Graduate School of Medicine of the University of Pennsylvania.

DR. Z. I. KERTESZ, associate in research in chemistry at the New York State Agricultural Experiment Station, Geneva, and assistant professor of chemistry at Cornell University, has been promoted to be chief of chemical research at the station and has been promoted to a professorship of chemistry at the university.

COLONEL GLEN E. EDGERTON, U. S. Army, engineer of maintenance at Panama, has been named governor of the Panama Canal.

DR. R. B. JACOBS, formerly instructor in physics at Harvard University and Lalor Fellow at the Massachusetts Institute of Technology, has been appointed assistant secretary of the National Research Council. He took up the work on July 15.

THE *Journal* of the American Medical Association states that Dr. William T. Green, assistant professor of orthopedic surgery, Harvard Medical School, has been made director of the after-care clinic of the Harvard Infantile Paralysis Commission. Dr. Green has charge of one of the two main divisions of the scientific work of the commission. The clinic in the Children's Hospital cares for about 1,400 children annually and conducts investigations of methods of treatment of infantile paralysis and of its after-effects. Dr. William Lloyd Aycock, assistant professor of preventive medicine and hygiene, Harvard Medical School, is in charge of the division of laboratory research, including study of the causation and epidemiology of the disease. The commission was established by the Harvard Corporation in 1916.

DR. WILLIAM CRAMER, a German by birth, for more than twenty-five years a member of the Imperial Cancer Research Fund, London, has joined the staff of the Barnard Free Skin and Cancer Hospital, New

York City, where he will study the early stages of cancer in animals. The appointment of Dr. Cramer has been made possible by an anonymous donor, who provided sufficient funds to bring him to the United States for a year.

NEWTON B. DRURY, of the California State Park System, has been appointed to succeed Arno B. Cammerer as director of the National Park Service. Mr. Cammerer has been transferred to Richmond, Va., where he will serve as regional director. Miner R. Tillotson will be transferred from the directorship of Region One to that of Region Three, covering the Southwestern states, with headquarters at Santa Fe, New Mexico. Colonel John R. White, now regional director at Santa Fe, will be transferred to San Francisco, Calif., to take up there the work of regional director of Region Four, in the Far West, and Frank A. Kittredge, regional director of Region Four, will become superintendent of Grand Canyon National Park, Arizona.

Nature reports that Dr. S. S. Bhatnagar, professor of chemistry at the University of Lahore, has been lent for two years to the Government of India as director of scientific and industrial research.

ACCORDING to the London *Times* the trustees of the Lady Tata Memorial Fund have decided that if circumstances permit grants will be made during the academic year beginning on October 1 to defray the expenses of research in blood diseases, with special reference to leukemia. Grants have therefore been tentatively awarded to Dr. M. P. J. Guérin, Paris; Professor K. Jármai, Budapest; Professor E. L. Opie and Dr. J. Furth, New York; Dr. A. H. T. Robb-Smith, Oxford; Dr. Werner Jacobson, Cambridge.

PHILIP E. PRATT, who recently received the doctorate in organic chemistry at the State University of Iowa, and Allison S. Burhans, a graduate of Duke University, have been appointed members of the research and development staff at Bloomfield, New Jersey, of the Bakelite Corporation, Unit of Union Carbide and Carbon Corporation.

DR. LOUIS A. KAZAL, of Rutgers University, has been appointed a member of the staff of the Biochemical Laboratory of the Medical Research Division of Sharp and Dohme, Glenolden, Pa.

DR. ENRICO FERMI, of Columbia University, recently gave a lecture on "Energy Production in Stars" at the University of Chicago, where he is visiting professor of physics.

DR. M. RUIZ CASTANEDA, director of the Department of Medical Research of the General Hospital, Mexico City, has returned to Mexico after visiting scientific institutions in the United States. He gave lectures on his work on typhus before the Rockefeller Institute for Medical Research, New York City; the Hoagland Laboratories, Brooklyn; the Institute of Medicine, Chicago, and the Mayo Foundation, Rochester, Minn.

THE council of the British Medical Association has decided, in view of the present situation, not to hold the annual representative meeting provisionally arranged for July 19 and 20.

THE Semicentennial of the Biological Laboratory at Cold Spring Harbor, now of the Long Island Biological Association, was celebrated on June 29, 1940. Addresses were made by Arthur W. Page, president of the association; Professor Harold C. Urey, of Columbia University, and Dr. Robert Cushman Murphy, of the American Museum of Natural History. After a tea at Blackford Hall a series of exhibits was shown at the John D. Jones Laboratory, including among others the electric potentials of the electric eel, the living frog heart and of a marine algal cell, *Valonia*, and the application of electrophoresis to protection against allergies. In his address Dr. Urey stressed the importance of the Cold Spring Harbor Symposia and the appreciation of men of science of the people of the community who as patrons of the laboratory have given it financial aid and active interest. Dr. Murphy emphasized the special value of the laboratory due to its location inside the metropolitan district and the part it has played in improving biological instruction.

THE Massachusetts Institute of Technology has established a department of building engineering and construction, of which Professor Walter C. Voss has been appointed chairman. Associated with him on the staff will be Professor Dean Peabody, Jr., Howard R. Staley and Albert G. Dietz. The program of the new department will be based on the work of the course in building engineering and construction, which for several years has been given in the department of civil and sanitary engineering.

DISCUSSION

THE SAMPLING ERROR OF THE MEDIAN

If σ be the standard deviation of a universe about its mean, the standard deviation of the mean of random samples of n drawn from the universe is always σ/\sqrt{n} ,

no matter how small n may be. The classic example of a universe for which the sampling error of the mean is infinite is

$$\varphi = \frac{1}{\pi} \frac{1}{1+x^2} \quad (1)$$

for which σ is infinite. It is usually pointed out that the median of this universe is $x=0$ and that the standard deviation of the median of random samples of n drawn therefrom is obtainable from the usual formula

$$\sigma_M = \frac{1}{2\varphi_M \sqrt{n}} \quad (2)$$

where φ_M is the value of φ at the median M , or, here, $\sigma_M = \pi/(2\sqrt{n})$ and is finite.

That the formula (2) for the standard deviation of the median can not be universally valid like the formula σ/\sqrt{n} for the mean may be seen from considering the two functions

$$\varphi = \frac{3}{2} x^2, |x| \leq 1 \quad (3)$$

$$\varphi = \frac{1}{4} \frac{1}{\sqrt{|x|}}, |x| \leq 1 \quad (4)$$

in the first of which $\varphi_M = 0$ so that (2) would make σ_M infinite, although it is surely less than 1, and in the second of which $\varphi_M = \infty$ so that (2) would make $\sigma_M = 0$, although that is highly improbable.

As a matter of fact, if one refers to the proof of (2) as ordinarily given, one sees that it depends on the fraction $(\frac{1}{2})$ of the n values in the sample which fall to one side of the median of the universe, and that this deviation $1/(2\sqrt{n})$ is converted into a deviation of the median of the sample itself by assuming that the area $\varphi_M \sigma_M$ is $1/(2\sqrt{n})$. When the function φ is changing very rapidly at its median M it would seem that a better statement of this assumption would be

$$\int_{-\sigma_M}^{\sigma_M} \varphi dx = \frac{1}{\sqrt{n}},$$

where the origin for x had been taken at the median of $\varphi(x)$. Indeed if this be used in the two cases above it will appear that

$$\sigma_M = \frac{1}{\sqrt{n}} \quad \sigma_M = \frac{1}{n} \quad (5)$$

respectively, instead of ∞ and 0, and that the standard deviation of the median need not vary inversely as the square root of the number in the sample.

However, though the result is better, it is not perfect. It would be necessary to have recourse to a true expression for σ_M . If n be odd, as $n=2k+1$, the median of the sample will be the middle element. If

$$F(x) = \int_{M=0}^x \varphi(x) dx$$

the chance that the median of the sample be at x is

$$\psi(x) dx = \frac{(2k+1)!}{(k!)^2} \left(\frac{1}{2} + F\right)^k \left(\frac{1}{2} - F\right)^k \varphi dx$$

The mean value of the median of random samples will not in general be at the median of the universe (taken as origin), though it must be so for a symmetrical universe, to which we shall here confine our attention; then

$$\sigma_M^2 = \int x^2 \psi(x) dx, \quad (6)$$

where the integration is extended over the whole range of the function φ .

If this formula be applied to (3) and (4) we find, respectively,

$$\sigma_M^2 = \frac{1}{\sqrt{\pi}} \frac{\Gamma\left(\frac{n}{2}+1\right) \Gamma\left(\frac{5}{6}\right)}{\Gamma\left(\frac{n}{2}+\frac{4}{3}\right)} \quad \text{and} \quad \sigma_M^2 = \frac{3}{(n+2)(n+4)}$$

where Γ denotes the gamma function. If Stirling's formula be applied to the Γ -functions, it may be shown that for n large the variation of σ is according to the powers of n indicated in (5) but that the coefficients are not unity but approximately 0.90 in the first case, whereas it is 1.73 in the second.¹

If (6) be applied to (1) it may be shown that for random samples of $n=3$ drawn from that universe the standard deviation of the median would be infinite, but for $n=5, 7, \dots$ would be finite. Finally, the application of (6) to

$$\varphi = \frac{4}{(e+|x|) [\log(e+|x|)]^2}$$

will show that the standard deviation of the median of samples of $n=2k+1$ will be infinite, no matter how large n may be,² although the function φ has a sharp beak ($\varphi_M=4/e=1.5$) at $x=0$, and appears to fall away very rapidly as x increases, being less than .007 at $x=\pm e$.

EDWIN B. WILSON

HARVARD UNIVERSITY

THE PUBLICATION OF ISIS

THE publication of *Isis*, an international and polyglot quarterly devoted to the history and philosophy of science, was begun in Belgium in 1912-13. Hardly had five issues appeared (Volume 1 and the first half of Volume 2) when the publication was stopped by the German invasion. After the war Volume 2 was completed and distributed without extra charge to the

¹ The general case $\varphi = C|x|^{-p}$, with $|x| < 1$ and $p < 1$, leads to $\sigma_M^2 = 1/n^\alpha$ where $\alpha = 1/(1-p)$ by the area argument, whereas by the usual formula it leads to 0 or ∞ according as p is positive or negative, but by (6) to the value

$$\sigma_M^2 = \frac{\Gamma(\alpha + \frac{1}{2}) \Gamma\left(\frac{n}{2} + 1\right)}{\Gamma(\frac{1}{2}) \Gamma\left(\frac{n}{2} + 1 + \alpha\right)} = \frac{\Gamma(\alpha + \frac{1}{2}) 2^\alpha}{\Gamma(\frac{1}{2}) n^\alpha}$$

(approximately for n large).

It may be noted that for no value of p (except $p=0$ and $\varphi \equiv \frac{1}{2}$) in this sequence of frequency functions does the standard deviation of the median vary inversely with the square root of n .

² This would appear to be true for any symmetrical φ for which

$$\int_x^\infty \left(\int_x^\infty \varphi(x) dx \right)^k x^2 \varphi dx$$

diverges for every value of k .

early subscribers,¹ and further volumes were gradually issued; they were edited in the United States, but printed in Brussels, later in Bruges. On January 12, 1924, the History of Science Society was founded in Boston, in order to guarantee and promote the publication of *Isis*. The editor undertook to give the subscribers each year a volume of about 600 pages. In fact during the last sixteen years (1924-39) the members received not sixteen volumes, but twenty-five (Volumes VI-XXX).

This year Belgium was again invaded by the same enemy, and the publication of *Isis* was again interrupted. At the time of this second invasion several issues of *Isis* were in various stages of printing, to wit, No. 84 completing Volume 31 and the whole of Volume 32.

No. 83, though dated November, 1939, was so much delayed that it reached America only in 1940; we count it as the first number of 1940 (outside of it, our members received 648 pages in 1939). The corrected page proofs of Nos. 84 and 85 were mailed to Belgium on March 27 and May 8, respectively. The neutrality of Belgium was violated by Germany on May 10.

Members of the History of Science Society² having paid their subscription for 1940 will receive at least No. 84 without charge, as soon as it appears.

From 1941 on (Volume 33 ff.) *Isis* will be printed in the United States. The first American number will include a list of all the papers and reviews which were scheduled to appear in the last Belgian issues (No. 84 and Vol. 32). Authors of these papers and reviews are welcome to publish them in other journals, but they should warn the editors to whom they apply that publication in *Isis* is not abandoned and may occur sooner than we think.

The capacity of the American *Isis* will probably be smaller than that of the Belgian predecessor, but the editorial policy will remain essentially the same. In the face of the moral and social chaos endangering the whole world it is more necessary than ever to study as well as possible our most precious heritage, the heritage not of one nation but of the whole of mankind. It is equally necessary to interpret the philosophy and inwardness of science, of which our machines, whether they be useful or destructive, give us only a very imperfect and deceiving idea. The main function of the scientist is to approach nearer to the truth and to publish the results of his investigations as faithfully as he can. The purpose of *Isis* is to explain our past efforts in that direction and thus help us to continue them in the same spirit of devotion to truth and humanity.

Let me add a few words about *Osiris*, which was

founded in 1936 in order to relieve *Isis* of the longer papers, and thus to increase its capacity, variety and attractiveness. *Osiris* serves the same purpose as *Isis* but is restricted to longer papers; it is not supported by the History of Science Society, and hence subscriptions to it or correspondence relative to it should not be addressed to the secretary of the society, but to Dr. Alexander Pogo, Harvard Library, 189, Cambridge, Massachusetts. At the time of the German invasion two volumes of *Osiris* were being printed, to wit, Volume 8, dedicated to Paul Ver Eecke, historian of Greek mathematics, and Volume 9, dedicated to Max Meyerhof, historian of Arabian medicine. These two volumes will appear in due time, and we trust that they will be followed by many others.

GEORGE SARTON

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ZOOLOGICAL SOCIETY OF LONDON

THE effect of the war upon scientific societies in Great Britain is being felt in various ways, chiefly in reduced membership, accompanied by higher paper and printing costs for their scientific publications. In normal times the Zoological Society of London spends about £3,000 a year on its scientific publications—comprising the *Transactions* and the two series of *Proceedings*. But the society draws by far the greater part of its revenue from the shillings and sixpences of the general public who visit the London Zoo and Whipsnade.

During the war, the attendance of visitors has fallen to about one quarter of normal, so that, in spite of the utmost economy in running costs, and in spite also of the loyalty of its fellows (the total is still over 8,000, only a few hundred less than a year ago), it is operating at a very heavy loss. Thus, since the outbreak of war, it has only been able to publish about half the normal volume of work, and this will have to be further cut down in the near future. Meanwhile, papers are still being submitted in almost peace-time quantity, so that the publication of valuable work is being seriously delayed.

The society has stocks of its scientific publications—"Proceedings," "Transactions," "Zoological Record" and "Nomenclator Zoologicus"—for sale. Those desirous of completing their files of these works will, by purchasing lacunae now, materially assist the society in the continuance of its activities in these difficult times. *Bis dat qui cito dat*: help would seem to be urgently required if the society is not to break its long record of well over a century and suspend scientific publication (as well as some of its other activities) during the continuance of the war.

JULIAN S. HUXLEY

ZOOLOGICAL SOCIETY OF LONDON

¹ SCIENCE, 49: 170-71, 1919.

² Secretary-treasurer, Dr. H. R. Viets, 8 The Fenway, Boston.

SCIENTIFIC BOOKS

ELECTRICAL DISCHARGES IN GASES

Fundamental Processes of Electrical Discharges in Gases. By LEONARD B. LOEB. Pp. xviii + 717. 297 figures. New York: John Wiley and Sons, Inc. 1939. \$7.00.

It is the author's objective to present "the reader with the facts and conflicting views, and . . . thereafter throw the weight of his authority in whatever direction it should, in his opinion, go, giving his reasons in each instance." This aim establishes the tone of the treatment, which is refreshingly outspoken. There is always a full discussion of the facts which form the basis for the author's judgment. The style is clear and incisive.

The presentation has been systematized in a way that is a real help in grasping essentials in a situation. Advantages and disadvantages of a method, assumptions underlying a theory, alternative mechanisms in a process, and so on, are throughout consistently listed seriatim, 1, 2, 3, etc.

The detailed treatment accorded to many of the methods, particularly those used in investigating the properties of ions, gives the book almost the character of a laboratory manual in places.

The first three chapters as well as the sixth are devoted to ionic behavior—the measurement of ionic mobilities, the experimental data and mobility theory, the recombination of ions, their diffusion, and the formation of negative ions. This amounts to one third of the book. The author's great interest in ionic behavior has led him to go into historical and experimental details which would be in place in a monograph on gaseous ions. Here they distract attention from other aspects of gas discharges and even crowd some of these out.

A chapter on electron mobility serves as an introduction to a thorough treatment of the energy distribution in an accelerated stream of electrons. The Druyvesteyn, Morse-Allis-Lamar and Smit derivations are all given. The important effect of electron interaction in creating a Maxwellian distribution in glows and arcs is, however, only mentioned in one sentence and a single reference. Nor is the effect mentioned of the positive ions in a plasma in decreasing the electron mobility.

The important subject of probes is competently discussed, and is concluded with a pertinent section on sources of error in probe measurements. The author is slightly handicapped, however, because the space-charge limited current problem and allied problems are postponed to a later chapter, with no perceivable advantage.

Ionization by electron collision is treated statistically and the relation is derived between Townsend's α and the differential ionization just above the ionization potential. But the general course of the differential ionization curve as well as values of total ionization and the formation of multiply charged ions are not discussed.

Another chapter is devoted to the second Townsend coefficient. It includes a critical discussion of spurious effects and summarizes alternative explanations.

An excellent treatment of sparks in the penultimate chapter is divided into three parts: theory, techniques in study and special types of breakdown including, among others, vacuum sparks, corona and lightning.

One reaches the final chapter on glows and arcs realizing that although one of the important applications of electrical discharges is to lighting, there has been no treatment of excitation and radiation.

Unfortunate confusion arises in this last chapter between glow and arc, and low and high pressure discharges. A "positive column" section under the glow discharge really deals with the low-pressure glow or arc, while a similar section under arcs deals with the high-pressure arc. The same is true of the two "anode fall" sections. Thus, the generally false impression is created at this point that arcs can not be low-pressure affairs and that they can not have low current densities.

This chapter is inadequate in other respects. The low-pressure positive column in which ions fall, without impact, to the wall is not mentioned although it has had far better experimental confirmation than the quasi-neutral diffusion case. It would be desirable to know what the effect is of a magnetic field on the arc and that current limiting factors exist. Of comparable importance to sparking is the disappearance of ionization after the interruption of an arc and the application of such de-ionization to the thyatron principle, but this is not discussed.

There are three appendices, one on the kinetic nature of a gas, the others consisting of a table of critical potentials and a table of physical constants.

The extremely comprehensive author and subject indices as well as the wealth of direct references are valuable features.

LEWI TONKS

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THE ULTRACENTRIFUGE

The Ultracentrifuge. By THE SVEDBERG and KAI O. PEDERSEN, in cooperation with J. H. BAUER, E. G. PICKELS, G. BOESTAD, E. O. KRAEMER, J. B. NICHOLS,

O. LAMM, A. S. MCFARLANE, R. SIGNER. Pp. x + 478. 174 figs. New York: Oxford University Press. \$12.50.

AN ultracentrifuge is defined by Professor Svedberg as a centrifuge in which convection-free sedimentation can take place. Such an instrument is a valuable tool, first for the determination of particle or molecular sizes and weights and, second, for the purification or concentration of various materials. In this book the authors deal principally with the first of the above applications, together with the design and construction of the various types of ultracentrifuges which they have used.

About four fifths of the book is written by the two principal authors, The Svedberg and K. O. Pedersen, and one fifth by the cooperating authors. Each of the contributors is especially well qualified to discuss his particular topic and the book is thoroughly authoritative.

The subject-matter is divided into four parts. Part I is a detailed and critical discussion of the theory of sedimentation by Svedberg and Pedersen, with a chapter at the end by Kraemer. The equations are derived for the two cases usually employed for the determination of particles or molecular sizes and weights, *i.e.*, for sedimentation equilibrium and for sedimentation velocity. The theory of sedimentation equilibrium is discussed, not only for uncharged particles and molecules but also for the case of salts, colloidal electrolytes and mixtures where equilibrium exists between several components.

Part II describes the construction and operation of the various types of ultracentrifuges. A most interesting review is given by Svedberg, Boestad, and Pedersen of the development of the Svedberg ultracentrifuges, as well as a detailed description of his most recent types now in use at Upsala. These include both the low-speed centrifuges used mostly for sedimentation-equilibrium measurements and the high-speed oil turbine ultracentrifuge with which Professor Svedberg

and his students have carried out so many epoch-making experiments. The discussion of the design and construction of the rotors and cells are of special interest to any one interested in centrifuge design, since the principles may be used for any type of rotor. Part II closes with a valuable chapter by Bauer and Pickels on the air-driven ultracentrifuges which they have used in their work.

Part III gives a most useful discussion of the methods of measuring the concentration gradients in the ultracentrifuge cell which are necessary for the determination of molecular or particle weights and sizes. The authors of this part are Pedersen, Lamm, and Kraemer.

Part IV deals with the results obtained with the Svedberg ultracentrifuges. The first section, written by Pedersen, presents and discusses the results obtained with animal and plant proteins. McFarlane contributes a chapter on the plant virus proteins. The second section presents the results on organic colloids (except proteins) and is written by Kraemer, Nichols, Signer, and Pedersen.

The appendix contains tables of constants and other data necessary for calculating the results from the experimental data. The bibliography contains practically a complete list of papers dealing with ultracentrifuge technique and data.

Although, as stated in the preface, the authors have confined themselves to a discussion of their own types of ultracentrifuges and the results obtained with them, the theory and methods presented are largely applicable to any type of ultracentrifuge. Also, the results are illustrative of the usefulness of the ultracentrifuging technique. Professor Svedberg and his collaborators have rendered a great service in writing this indispensable handbook to every one interested in using any type of ultracentrifuge or in the interpretation of sedimentation data.

J. W. BEAMS

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SPECIAL ARTICLES

ON THE IDENTITY OF VITAMIN H WITH BIOTIN

IN a recent communication¹ we called attention to the possible identity of vitamin H, the curative factor for egg-white injury in rats,² with biotin,³ a growth factor for yeast, and with coenzyme R,⁴ a growth and respiration factor for many strains of legume nodule

¹ P. György, D. B. Melville, D. Burk and V. du Vigneaud, *SCIENCE*, 91: 243, 1940.

² P. György, *Jour. Biol. Chem.*, 131: 733, 1939.

³ F. Kögl and B. Tönnis, *Zeits. Physiol. Chem.*, 242: 43, 1936.

⁴ F. E. Allison, S. R. Hoover and D. Burk, *SCIENCE*, 78: 217, 1933.

bacteria. The identity of biotin and coenzyme R had already been indicated by other investigators.^{5,6} Our conclusion that vitamin H and biotin were either identical or very closely related compounds was based on the close parallelism that was found to exist in the distribution and in the chemical and physical behavior of the substances, as brought out both by our own experimental work and by data derivable from the literature.

It was found that no important differences in dis-

⁵ P. M. West and P. W. Wilson, *SCIENCE*, 89: 607, 1939.

⁶ R. Nilsson, G. Bjälfve and D. Burström, *Naturwissenschaften*, 27: 389, 1939.

tribution could be discovered, when the differences in sensitivity of the assay methods for vitamin H and for biotin and coenzyme R were considered. The solubilities of these three factors in various organic solvents, their heat stability, low molecular weight, adsorption phenomena, stability toward acid and alkali and the effects of reagents such as nitrous acid, benzoyl chloride, acetic anhydride and lead acetate, all pointed to the probable identity of the factors. The strikingly parallel distribution of biotin, coenzyme R and vitamin H activities in the electrodialysate fractions from our vitamin H liver concentrates added particularly convincing evidence for the identity of the three factors. Additional work on biotin and vitamin H which we have since carried out brought still further confirmation.

Conclusive proof of the identity of these principles, as we previously noted, had to await the testing of the pure substances for the mutual activities. This has now been facilitated through the kindness of Professor F. Kögl, who has placed at our disposition for vitamin H assay a solution of 150 γ of crystalline biotin methyl ester in ethyl alcohol. We wish to take this opportunity to express our sincere appreciation for this generosity and cooperation.

In order to obtain some indication of the level at which the biotin methyl ester should be tested for vitamin H activity by the rat assay method, the yeast-growth activity of this solution was compared with that of a solution of known vitamin H activity. A modification of the method of Snell, Eakin and Williams⁷ was employed, using *Saccharomyces cerevisiae* Strain 139 as the test organism. Yeast growth was determined by turbidity measurements in the Klett-Summerson photoelectric colorimeter. The curve obtained by plotting turbidity readings against the logarithm of the concentration of the substance being assayed was used to determine the concentration at which half the maximum increase in growth occurred. The half-maximum growth increase was found to be more accurate than either maximum or minimum growth concentrations for comparison of various samples in the calculation of activity. It was found that biotin methyl ester produced a half-maximum growth increase at a concentration of 1 part in 4×10^9 . A vitamin H preparation containing 34 units of vitamin H activity per mg produced the same yeast-growth effect at a concentration of 1 part in 1.36×10^7 . It could be predicted, therefore, that the biotin methyl ester should show an activity of approximately 10,000 units of vitamin H per mg by the rat assay method if biotin and vitamin H were identical.

Twenty-six rats showing definite vitamin H deficiency symptoms^{2,8} were used for assay of the solu-

tion of crystalline biotin methyl ester at various levels above and below the amount indicated by the yeast assay. Subcutaneous administration of the biotin ester brought about complete cure of the skin manifestations and resumption of growth in these animals. The minimum effective dose, within the limits of assay error, was found to be 0.1 γ per rat per day for 30 days. This corresponds to an activity of 10,000 units of vitamin H per mg for the methyl ester of biotin. The most potent vitamin H preparation hitherto reported¹ possessed an activity of 215 units per mg.

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MOBILIZATION OF VITAMIN A BY ALCOHOL

THE important observation of Clausen *et al.*¹ that, in dogs, vitamin A is mobilized from tissue stores by ethyl alcohol, as shown by actual blood analyses, probably applies also to humans. The Pett visual test for vitamin A deficiency,² has been correlated with blood analyses.³ Using this instrument, routine daily tests have been carried out on many people during the past two years. On several occasions unaccountably short recovery times (indicating higher blood vitamin A levels) have been observed the day following the taking of alcohol. Table I shows a few such incidental observations.

TABLE I

Subject	Previous average	Recovery Times		
		1st day after alcohol	2nd day after alcohol	7th day after alcohol
	seconds	seconds	seconds	seconds
A	9	5	6	8
B	10	7	8	9
C	15	8	..	12
D	19	9	9	16

* Smaller values equal higher blood vitamin A.

The observations of Clausen and his colleagues would now appear to explain these findings.

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⁸ "Medicine in its Chemical Aspects," Bayer, Leverkusen, Germany (1938), Vol. 3, p. 137.

⁹ S.M.A. Corporation Fellow.

¹ S. W. Clausen *et al.*, SCIENCE, 91: 318, 1940.

² L. B. Pett, *Jour. Lab. Clin. Med.*, 25: 149, 1939.

³ L. B. Pett, and G. A. LePage, *Jour. Biol. Chem.*, 132: 585, 1940.

⁷ E. E. Snell, R. E. Eakin and R. J. Williams, *Jour. Am. Chem. Soc.*, 62: 175, 1940.

ENZYMATIC LIBERATION OF AUXIN FROM PLANT TISSUES

RECENTLY it has become increasingly clear that the quantitative extraction of auxin from green tissues by the use of solvents is attended with considerable difficulty. In a study of this problem,¹ using *Lemna minor*, grown under controlled conditions, as source material, and the standard *Avena* method for auxin assay, we have found that complete removal of the auxin present is obtained only after repeated extractions spread over a period of several months. This is true even when ether, which was found to be the most suitable solvent, was used. It is true also for a number of different plant tissues.

The results which we have obtained by several methods demonstrate that the slowness of the extraction is due to the very gradual liberation of free auxin from some bound form. From the behavior of the material in regard to boiling and drying, it was deduced that this liberation is in the main enzymatic and probably hydrolytic in nature. In order to hasten the extraction, the effect of adding some proteolytic enzymes, available in pure form, has been investigated. It was found that crystalline trypsin brings about a small increase in yield, while chymotrypsin was highly effective under the conditions used. When duplicate samples of ground and dried *Lemna* were allowed to stand 24 hours at pH 8 and room temperature, and then acidified and extracted with ether, the yield of auxin was increased from 20 units in the control to 93 units in the enzyme-treated sample. Incubation with the enzyme at 37° C was still more effective.

In the table are given the results of one such experiment. Fresh *Lemna* was rapidly dried, kept at 70° C overnight, ground and divided into samples weighing 0.365 gms, corresponding to 3.0 gms fresh weight each. Water was added to all samples and some were boiled for 15 minutes. Another sample was cytolysed with ether, ground thoroughly with water, and the extract divided into two 3 cc portions. All samples were brought to pH 8 with Na₂CO₃, enzyme added where necessary, and the final volumes of the solutions brought to 2 cc. After 24 hours' incubation at 37°, the samples were acidified and extracted with ether (first extraction). They were then kept under ether for two further periods of 7 and 8 days, respectively, and the extracts so obtained, together with the rinsings, also tested.

Table I shows that both in the boiled and unboiled material, the enzyme increases the yield from three to four times. In another experiment increases as great as six times have been obtained with as little as 0.1 mg enzyme. Controls on the chymotrypsin solution alone, either fresh or carried through the procedure above, gave in 3 out of 4 experiments no auxin at all; on

¹ Details of the work will be published elsewhere.

TABLE I
EFFECT OF CHYMOTRYPSIN ON THE YIELD OF AUXIN FROM LEMNA MINOR*

	First extraction	Second + third extraction	Total
Unboiled material			
Control	250	310	560
Chymotrypsin 1 mg ...	1144	884	2028
Chymotrypsin 5 mg ...	638	982	1620
Boiled material			
Control A	138	157	295
Control B	203	89	292
Chymotrypsin 1 mg ...	469	582	1051
Chymotrypsin 5 mg ...	313	505	818
Water extract			
Control	101	114	215
Chymotrypsin 5 mg ...	280	118	398

* All data in units per cc per 3 gms fresh weight.

one occasion 12 units per 5 mg were obtained. The greatly increased auxin yield could therefore not be the result of either active impurities or decomposition products of the enzyme itself.

The results with the water extract are suggestive rather than significant, but they are included because they set an upper limit to the amount of activity which could possibly have been contributed by the enzyme.

It may be concluded that the auxin in *Lemna* is bound to a protein, from which it is liberated on hydrolysis. It is probable that this conclusion applies to a variety of plant tissues.

FOLKE SKOOG

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